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(71) Applicant *(for all designated States except ES US)*: BRITISH UNITED SHOE MACHINERY LTD. [GB/GB]; Ross Walk, P.O. Box 88, Belgrave, Leicester LE4 5BX (GB).

(71) Applicant *(for ES only)*: USM ESPANA, S.L. [ES/ES]; Ramon Turro, 109-5° planta, Apartado 21083, E-08005 Barcelona (ES).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: GREATOREX, Anthony, Thomas [GB/GB]; 1068 Melton Road, Syston, Leicester LE7 2NN (GB). THOMPSON, David, Alan [GB/GB]; 119 Heathcote Drive, Sileby, Leicester LE12 7NB (GB).

(74) Agents: PARNHAM, Kevin et al.; USM Texon Ltd., Ross Walk, P.O. Box 88, Belgrave, Leicester LE4 5BX (GB).

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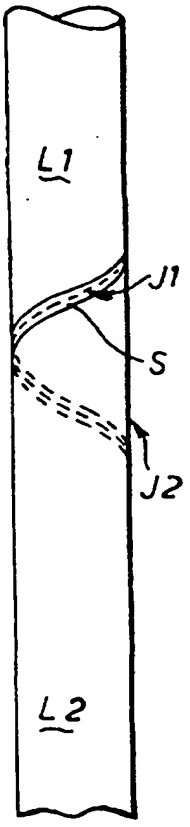
(57) Abstract

To form a continuous length of flexible sheet material from which a tubular product may be produced a plurality of individual lengths (L1, L2) are secured together end to end. Adjacent ends of adjacent lengths are cut at an angle other than 90°, preferably 30-60°, more preferably 45°, to the lengthwise dimension such that when the tube is formed a spiral-shaped joint is formed. The joint (J1, J2) may be stitched, bonded or welded, the latter being preferred where the sheet material is e.g. a non-woven fabric with a backer layer laminated to one side; in such case a strip of the same material as the backer may be applied to the lengthwise edges of the backer and be welded to it.



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MANUFACTURE OF TUBULAR PRODUCTS

This invention is concerned with a method of manufacturing a tubular product from lengths of flexible sheet of material and a tubular product, e.g. a pipeline repair/ renovation product, made by such a method.

Such methods are known comprising procuring a length of flexible sheet material and progressively bringing the lengthwise edge or marginal portions of such length together, thus to form the length into a tubular configuration, and thereafter securing said edge or marginal portions together, thus to form the length into a continuous tube.

It will be appreciated that whereas material can be produced in relatively long lengths, e.g. up to, say, 250 metres, it will be necessary from time to time, according to the desired length of the finished tube, to join one or more individual lengths end to end. Typically such a joint has been so made that it lies substantially at right angles to the lengthwise dimension of the tube.

One use for tubular products of the type referred to is in the renovation and/or repair of pipelines in a so-called trenchless or "no-dig" process, in which formed tube is drawn through the pipe to be repaired or renovated and then secured in position. In drawing the tube through the pipe, clearly tensions are created within the tube and thus any bond of individual lengths must be strong enough to withstand such tensions. Moreover, such joints may be bulky and also may reduce the overall flexibility locally, in the tube.

It is thus one of the various objects of the present invention to provide an improved method of manufacturing a tubular product from lengths of flexible sheet material, which lengths have been secured together end to end, wherein the joints between adjacent individual lengths do not constitute

an area of weakness.

It is further one of the various objects of the present invention to provide an improved method of manufacturing a tubular product from lengths of flexible sheet material, which lengths have been secured together end to end, wherein said joints do not significantly affect the flexibility of the tube or increase significantly its bulk.

The present invention thus provides, in one of its several aspects, a method of manufacturing a tubular article from lengths of flexible fabric sheet material comprising securing together end to end a plurality of lengths of material to form a single continuous length, progressively bringing the lengthwise edge or marginal portions of the single continuous length together, thus to form said length into a tubular configuration, and securing said edge or marginal portions together, thus to form the single continuous length into a continuous tube, characterised by, for forming a single continuous length from the plurality of lengths, cutting adjacent ends of adjacent lengths of the sheet material at an angle other than 90° to the lengthwise dimension of the lengths such that when edge or marginal portions of the cut ends are brought together they form a substantially continuous run, and bringing the edge or marginal portions of the cut lengths together and, while maintained in such condition, joining them together by applying a strip of material so as to overlap the ends and securing said ends to said strip thus to create a single continuous length of material, whereby a spiral-shaped joint is formed between the adjacent ends of the adjacent individual lengths.

It will thus be appreciated that, in using the method in accordance with the invention, the length of the joint between adjacent individual lengths is now substantially greater, in terms of length, than the previously practised joint, the increased length being determined according to the angle at

which the ends of the lengths are cut, and thus the overall strength of the joint is increased.

In order not to waste material, on the one hand, or, on the other hand, fail to obtain the benefits of this invention, it has been found preferable that the angle subtended between the line of cut and the lengthwise dimension of the cut length is in the order of 30-60°, preferably 45°. It will of course be appreciated that in this latter case, the length of the joint is in the order of 2.414 × the length of the previously practised joint.

The invention is particularly applicable in the case of flexible sheet material in the form of a non-woven fabric coated on one side with an impermeable barrier layer. Such a fabric may be used in pipeline renovation and/or repair as referred to above. In carrying out the present invention, moreover, preferably using such a sheet material the strip of material which overlaps the cut ends of individual adjacent lengths is applied to the barrier layer and the barrier layer is secured to the strip at both sides of the joint. This manner of securing the two lengths together has been found particularly useful where the material is subsequently then formed into a tubular configuration with the barrier layer on the outside, since the latter and also the strip of material, being relatively inextensible, have the tendency to urge the abutting or facing edge or marginal portions of the non-woven material into surface contact with one another; it will be appreciated that with the previously practised joint this was not the case, this effect being of course achieved because of the spiral shape of the joint.

In a preferred embodiment of the invention the strip is made of the same material as the barrier layer. Suitable materials for the barrier layer and strip have been found to be ionomer resins, polyurethanes and polyethylene.

Preferably, furthermore, the strip of material is secured

to the barrier layer by the application of heat and pressure alone; that is to say the strip is effectively welded to the barrier layer without the need for adhesive or the like. Moreover, in the particular case of the use of an ionomer resin, e.g. Surlyn, it has been found advantageous to secure the barrier layer portions to the strip of material as aforesaid at a temperature in the order of 130°C for a period of up to 10 minutes, thus to ensure a suitable bond or weld. ("Surlyn" is a registered trade mark of The DuPont Corporation.)

As an alternative, however, the strip of material which overlaps the cut ends of individual adjacent lengths may be applied to the barrier layer and be secured by stitching to the barrier layer and also to the non-woven fabric itself.

Also in carrying out the method in accordance with the invention, preferably in progressively bringing the lengthwise edge or marginal portions of the single continuous length together and securing them, said portions are first subjected to a heat treatment and thereafter, with the thus heated portions urged into contact with one another, a strip of material is laid in overlapping relation therewith and the assembly of strip and edge or marginal portions is subjected to pressure whereby said portions are secured together and to the strip. In such a case, moreover, it will be appreciated that the portion of the thus formed lengthwise joint extending between opposite ends of the aforementioned spiral-shaped joint constitutes, in the formed tube, part of the joint between the adjacent ends of the individual lengths. In such case also, furthermore, where the sheet material includes a barrier layer as aforesaid, the strip of material is laid in contact with the lengthwise edge or marginal portions of the barrier layer.

Again, in the case of the lengthwise joint it has been found advantageous if the strip of material is made of the same material as the barrier layer; that is to say, the strip

of material used in welding or bonding the lengthwise edge or marginal portions of the lengths of material to form a continuous tube is conveniently the same material as that used in the welding of adjacent lengths together end to end. In such case, furthermore, preferably as the strip is progressively laid in overlapping relation with the edge or marginal portions it is subjected to heat treatment, e.g. a hot air blast.

The invention also provides, in another of its several aspects, a tubular product made by a method as set out above, and in particular a pipeline repair/renovation product made by such method.

There now follows a detailed description, to be read with reference to the accompanying drawings, of one method of manufacturing a tubular product. It will of course be appreciated that this method has been selected for description merely by way of non-limiting example of the present invention.

In the accompanying drawings:-

Figure 1 is a plan view showing adjacent ends of adjacent lengths of flexible sheet material cut at an angle to the lengthwise dimension prior to joining;

Figure 2 is a view showing a formed tube, with specific reference to the angular joint made between two individual lengths; and,

Figure 3 is a diagrammatic fragmentary view of tube-forming equipment used in carrying out the invention.

The method now to be described is concerned primarily with the manufacture of a continuous tubular product suitable for use in pipeline renovation and/or repair using a so-called trenchless or "no-dig" process. The length requirements for

such a tube will vary from job to job and can be as short as, say, 10 metres or be upwards of 250 metres. Where a significant length is required, therefore, it is necessary to secure individual lengths end to end in order to achieve the desired length.

In accordance with the present invention ends of two lengths L1, L2 of flexible material are cut at an angle such that a joint J1 subsequently formed therebetween extends obliquely across the width. Preferably the subtended angle is 45° to the lengthwise direction of each length.

The lengths L1, L2 are joined together along the join J1 by applying a strip of material S1 (see Figure 2) in overlapping relation with the adjacent ends of the lengths and securing said ends to the strip S1 under conditions of heat and pressure. The strip of material may be bonded or welded to the lengths L1, L2; alternatively the ends may be secured, without heat and pressure, by stitching. The particular method employed with a particular type of flexible sheet material will be described hereinafter.

It will be appreciated that in bringing adjacent ends of the lengths L1, L2 together the edge portions of the ends may be brought into abutting relationship and a butt joint formed. Alternatively, the ends may be part-folded over so that marginal portions of the ends are brought into surface contact and secured as aforesaid in that condition.

Referring now to Figure 2, it will be seen that when the thus joined continuous length is formed into a tubular configuration, the joint J1 is in the form of a spiral. Moreover, when the lengthwise edge or marginal portions of the tubular configuration are secured together, as will be described in detail later, the lengthwise joint J2 has a section extending between the ends of the spiral and such section effectively forms part of the joint J1 between the two lengths L1, L2, thereby increasing further the strength of the

latter joint, which is already enhanced by its angular, spiral configuration.

The material of the lengths L1, L2 may be any suitable material but is preferably a non-woven fibre fabric with a coating of a barrier layer on one side. In a preferred embodiment the non-woven fabric material is a polyester fabric and the barrier layer is constituted by an ionomer resin, e.g. Surlyn. Other suitable materials for the barrier layer have been found to be polyurethanes and polyethylene.

In forming a tubular product from such material the barrier layer may, according to the choice of the user be on the inside of the formed tube or on the outside. In the case where the barrier layer is on the outside, because the barrier layer is inextensible there is a tendency, especially when the joint J1 is effected by welding, for the non-woven fibre fabric edge portions to be urged together, thereby enhancing any sealing effect at the joint.

As in the case of joint J1, joint J2 may also be formed by stitching, bonding or welding, and again a welding process will be described hereinafter. Similarly, in bringing the lengthwise edges of the continuous length together, the edge portions may form an abutting relationship or the edges may be part-folded over and marginal portions of the edges brought into surface contact with one another prior to being secured together.

Referring now to Figure 3, a continuous length L of flexible fabric sheet material is progressively formed into a tubular configuration by passing it progressively over a former 10, which is of generally oval cross-section. The lengthwise edge portions of the length are arranged at the upper surface of the former 10 and these edge portions are advanced progressively past a heated blade 12 which has a temperature in the order of 430°C, thus to provide heat treatment for edge portions of the length of material. The

thus heated portions then continue to be fed between upper and lower pressure rollers 14, 16. Over the surface of the upper roller (14) is entrained a strip of material S2, which is thus pressed against the marginal portions of the lengthwise edges of the length L, as shown in Figure 3. Moreover, a nozzle 18 is provided by which air, heated to a temperature in the order of 550°C and at a pressure in the order of 1 bar, is directed towards the region between the rollers 14, 16 whereby to maintain the elevated temperature of the edges and also to heat the strip of material S2. In this way, therefore, the strip of material S2 is secured to both the lengthwise edges of the length L and welded thereto, thereby forming the length into a continuous tube.

The continuous tube can then be reeled and stored ready for use.

As already mentioned, in carrying out the preferred embodiment the barrier layer is of an ionomer resin, e.g. Surlyn. In addition, in carrying the aforementioned method the barrier layer is disposed on the outside of the tube when the latter is formed, so that the strip of material S2 is applied to the barrier layer. In such circumstances, the strip of material S2 is also of an ionomer resin, e.g. in the form of a tape 0.4 mm. thick and incorporating a backer having a thickness in the order of 0.1 mm. In other embodiments, the barrier layer may be of e.g. a polyurethane, in which case the strip of material S2 should be of the same or similar formulation; again, the barrier layer and the strip may be formed of polyethylene.

A continuous tubular product of the type thus made may be used in pipeline renovation and/or repair. In such case, the non-woven fabric layer will generally be impregnated with an epoxy resin or the like and the tube then be located within the pipeline to be renovated and/or repaired prior to the epoxy resin being hardened off to form a rigid tubular core within the existing pipe.

Claims:

1. Method of manufacturing a tubular article from lengths L1, L2 of flexible fabric material comprising

securing together end to end a plurality of lengths L1, L2 of material to form a single continuous length,

progressively bringing the lengthwise edge or marginal portions of the single continuous length together, thus to form said length into a tubular configuration, and

securing said edge or marginal portions together, thus to form the single continuous length into a continuous tube,

characterised by, for forming a single continuous length from the plurality of lengths L1, L2,

cutting adjacent ends of adjacent lengths L1, L2 of the sheet material at an angle other than 90° to the lengthwise dimension of the lengths L1, L2 such that when edge or marginal portions of the cut ends are brought together they form a substantially continuous run, and

bringing the edge or marginal portions of the cut lengths together and, while maintained in such condition, joining them together by applying strips of material so as to overlap the ends and securing said ends to said strips thus to create a single continuous length of material,

whereby a spiral-shaped joint J1, J2 is formed between the adjacent ends of the adjacent individual lengths L1, L2.

2. Method according to Claim 1 characterised in that the angle subtended between the line of cut and the lengthwise dimension of the cut length is 30-60°, preferably 45°.

3. Method according to either one of Claims 1 and 2 wherein the flexible sheet material is a non-woven fabric coated on one side with an impermeable barrier layer,

characterised in that the strips of material which overlaps the cut ends of individual adjacent lengths L1, L2 is applied to the barrier layer and the latter is secured to it.

4. Method according to Claim 3 characterised in that

the barrier layer and the strips of material are both made of an ionomer resin.

5. Method according to Claim 3 characterised in that the barrier layer and the strips of material are both made of a polyurethane or polyethylene.

6. Method according to any proceeding Claim characterised in that the securing process takes place at a temperature in the order of 130°C for a period of up to 10 minutes.

7. Method according to either one of Claims 1 and 2 wherein the flexible sheet material is a non-woven fabric coated on one side with an impermeable barrier layer,

characterised in that the strips of material which overlaps the cut ends of individual adjacent lengths L1, L2 is applied to the barrier layer and secured by stitching to the barrier layer and the non-woven fabric.

8. Method according to any one of Claims 1 to 7 characterised in that, in progressively bringing the lengthwise edge or marginal portions of the single continuous length together and securing them, said portions are subjected to a heat treatment and with the said portions urged into contact with one another, strips of material is laid in overlapping relation therewith and the assembly of strip and edge or marginal portions is subjected to pressure whereby said portions are secured together and to the strips,

and in that the thus formed lengthwise joint J1, J2 has a section extending between opposite ends of the spiral-shaped joint J1, J2, which section thus constitutes, in the formed tube, part of the joint between the adjacent ends of the individual lengths.

9. A tubular product made by a method according to any one of the preceding Claims.

10. A pipeline repair/renovation product made by a method according to any one of Claims 1 to 8.

1/2

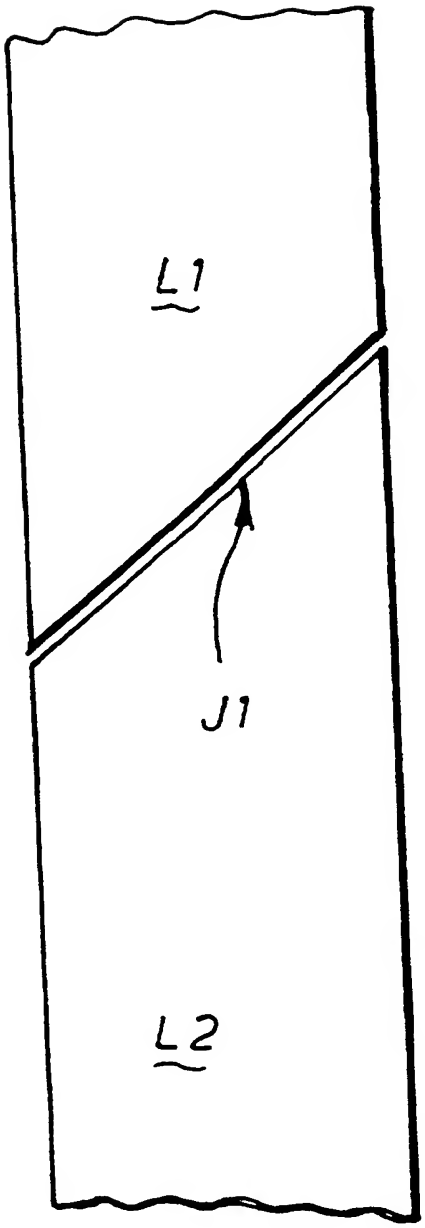

FIG. 1

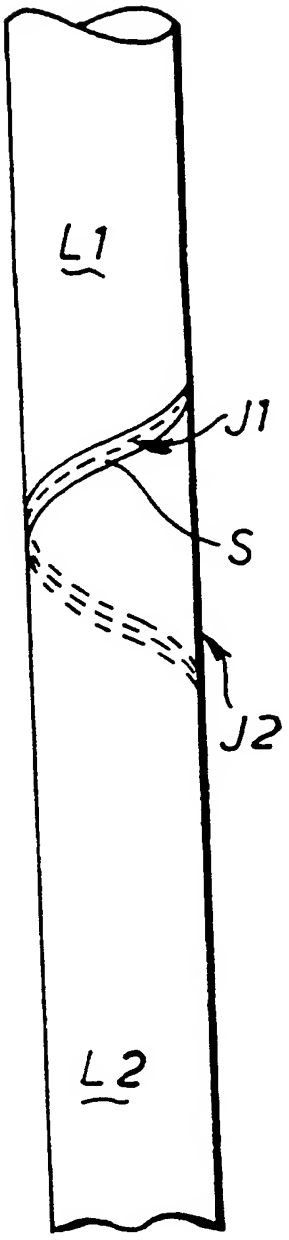

FIG. 2

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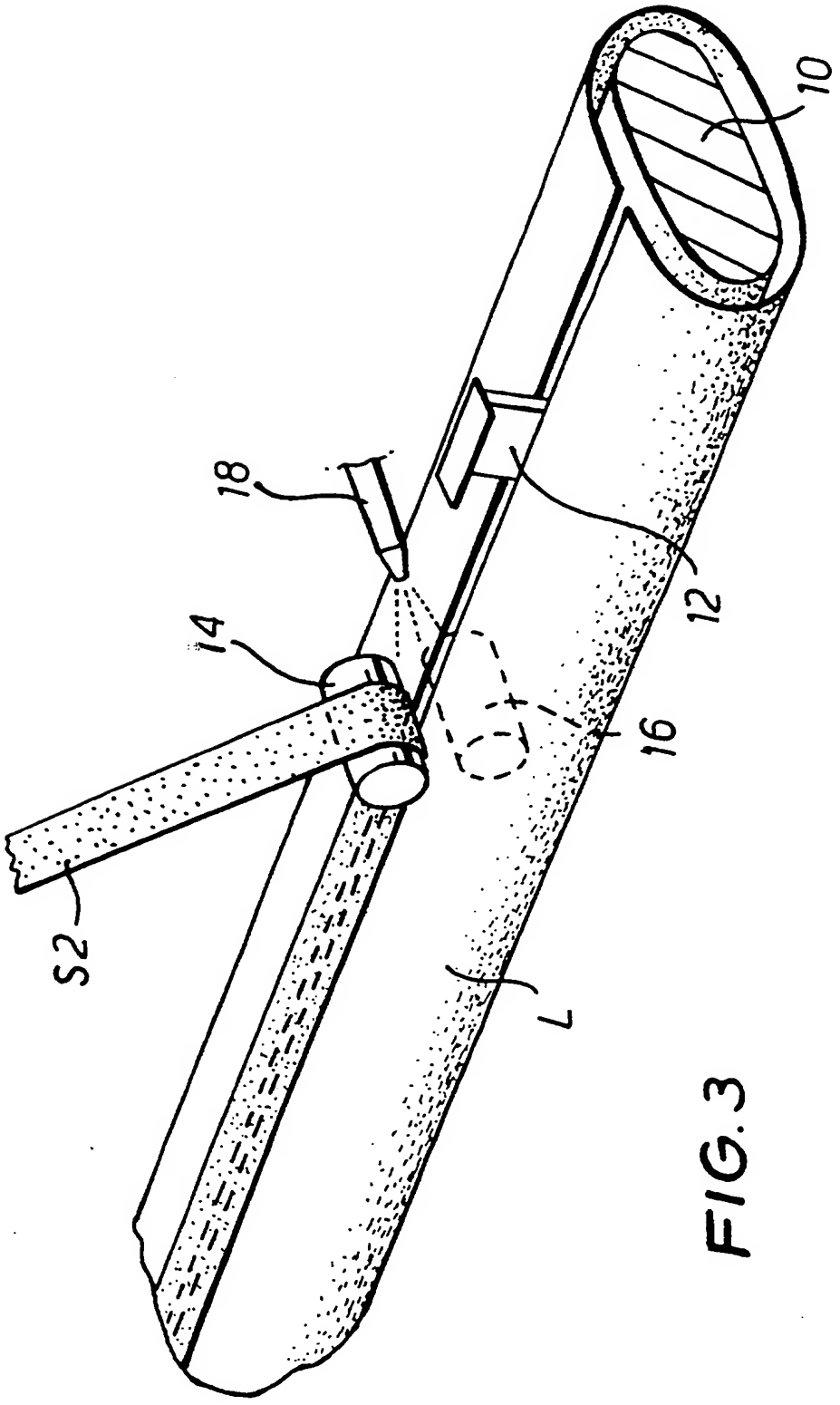

FIG.3

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
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Minimum documentation searched (classification system followed by classification symbols)
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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

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[X] Further documents are listed in the continuation of box C.

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